WSTIAC

Volume 1, Number 2
April 2000

WEAPON SYSTEMS TECHNOLOGY INFORMATION ANALYSIS CENTER

Modernizing Situational Awareness and Battlefield Management

by Mitchell W. Douglas

Contents

To prepare for changes in the 21st century, DoD has a modernization strategy to realize a Joint Vision 2010 and the Concept for Future Joint Operations. The strategy supports achieving dominance over the full spectrum, emphasizes information dominance and overmatch capabilities, and provides the focus for science and technology initiatives required for future operational capabilities. From the Army perspective, Joint Vision 2010 is the umbrella over a deliberate and orderly process for change over the next 25 years to include operational concepts; Force XXI, Army Vision 2010, Army After Next (AAN), and Army 2025.

With respect to information dominance, DoD has a vested interest to modernize situation awareness and battlefield management systems. By applying innovative technology solutions to sensors, processors, and communication systems every military participant – from the soldier to the commander – can maintain a clear and accurate picture of the battlespace. The result is a more effective means of planning and executing the mission. And now with the push for a digitized battlefield, the source of information dominance may be in the for of a Smart Sensor Web (SSW) system.

As reported in the CORE Weekly Report for 4/26/99 (http://core.cast.msstate.edu #199), The Deputy Under Secretary of Defense for Science and Technology, Delores Etter, has indicated in testimony before the Senate Armed Services Subcommittee that one of the future priority areas for Defense Science and Technology include smart sensor webs. The SSW initiative is intended to take advantage of advances in information technology, sensors and microelectronics to provide a web-centric fusion of sensors from ground, sea, air, and space to enhance the commander's situational awareness.

Historically, the concept of an integrated system for gathering and disseminating information has been realized as an advantage in dominating battlefield situational awareness. Initiated in 1984, the Army started the development of the All Source Analysis System (ASAS) in support of Intelligence & Electronic Warfare. The ASAS was designed as

continues, page 2 ➤

WSTIAC is a DoD Information Analysis Center Sponsored by the Defense Technical Information Center and Operated by IIT Research Institute

➤ continued from page 1

a functionally integrated intelligence support system, which manages sensors and other resources; collects, processes, and fuses intelligence data; stores, manipulates, and displays this data; and quickly disseminates information to the commander by providing a common picture of enemy activity to all battlefield assets. The Air Force has a similar system called Enemy Situation Correlation Element (Ensce) which is combined with ASAS to form a Joint Tactical Fusion (JTF) node in support of the Intelligence & Electronic Warfare battlefield functional area.

Today, the U.S. Navy has adopted Network – Centric Warfare as the latest Revolution in Military Affairs. This concept has the potential for wide application in the Joint Arena, where rapid rate of data and information assimilation, fusion, and dissemination offer the Joint Force Commander the potential to achieve dominant battlespace awareness. This concept envisions the combination of advanced sensors, weapons, and C4I systems from geographically dispersed units networked together to communicate and share information.

At the center of the Navy's vision of Network-Centric Warfare is a program known as cooperative engagement capability or CEC. CEC has been a Navy priority since shifting its war-fighting focus from the deep oceans to littoral operations where there exists a bigger threat against ships from enemy missiles. The program is demonstrating sensor-networking technologies capable of collecting data from ship-based and airborne sensors providing a real time picture of the target to participating platforms in a naval battle group. The goal is to prioritize which platform and what weapon system will be used to engage the target. The technology is designed to give the naval commanders multiple options for defeating incoming missiles given a single integrated air picture.

The technology associated with this program is not to be confused with a combat system or a communications network. CEC integrates the collection, processing and distribution of sensor and weapons data from existing ships and patrol aircraft. The data is filtered and fused, then distributed to all other platforms in the battle group.

It is planned to integrate CEC with Army ground systems, such as Patriot anti-missile system to test how CEC works with the Army system using data from a Navy Aegis radar-equipped ship. The test, called "engage on remote", is planned this fall at Eglin Air Force Base, FL. An Aegis cruiser will be used to track a surrogate cruise missile, and CEC data will be passed through the Patriot battery and the system will fire at the target using the CEC data. The threat will be outside the Patriot's radar horizon. Other plans include linking CEC with the Air Force AWACS and Joint STARS C3I platforms as well as UAV systems.

It is recognized advances need to be made in hardware technology to develop such SSW type systems. DoD is investing in technologies to make sensors smarter, hardware smaller using micro electro-mechanical systems (MEMS), and increase data processing bandwidth using LASER communication. However, the defense technology cycle is typically longer than the eighteen-month cycle of technology in the commercial sector. Therefore, there must be a merger of technologies in the two arenas to include programs such as Domestic Technology Transfer, Commercial Operations and Support Savings Initiatives, and the Dual Use Science and Technology Program.

WSTIAC Wants Your Contributions

- We hope you find this issue of the WSTIAC Newsletter useful and interesting. You can help us to better serve you by your contributions, such as:
- Your comments on what you liked and disliked about the Newsletter
- Your suggestions for WSTIAC data products and services
- Technical articles, opinion pieces, tutorials, news releases or letters to the Editor for publication in the Newsletter
- To contact WSTIAC, use any of the ways listed on the back cover, or use the feedback form on the WSTIAC webpage
- We welcome your contributions.

REMIDS

Remote Identification System

by Morris Fields

The REMote IDentification System (REMIDS) is used for the surface UXO identification aspect of the UXO detection problem. The U.S. Army Corps of Engineers, Engineer Research and Development Center, Waterways Experiment Station (WES) developed the Remote Minefield Detection System(REMIDS for standoff minefield detection. REMIDS was successfully integrated in a U.S. Army Aviation Technical Test Center (ATTC) UH-60A helicopter and demonstrated at the U.S. Army Standoff Minefield Detection System (STAMIDS) Advanced Technology Transition Demonstration (ATTD), Phases I and II, at Fort Hunter-Liggett, California, and Fort Drum, New York, respectively. REMIDS was demonstrated in the Environmental Security Technology Certification Program (ESTCP) at Yuma Proving Grounds, Yuma, Arizona.

The system is flown in an UH-60A Blackhawk helicopter, and consists of an active/passive infrared line scanner, real-time data processing and display equipment, and navigational equipment. The scanner collects three channels of optically aligned image data consisting of two active laser channels and a passive thermal infrared channel. The concept of the active laser channels consists of transmitting a beam of linearly polarized IR laser light, and collecting the reflected parallel and perpendicular components. From these two measurements, the polarization, and reflectance of the object can be calculated.

Man-made materials usually have a very different polarization, reflectance and thermal signatures than naturally occurring ones, causing them to stand out in the real-time display. Detection and classification of materials is made by comparing the polarization, reflectance and thermal signatures from the image data with ranges for know materials. Man-made materials typically have a higher reflectance and polarization than naturally occurring materials. At times of greatest temperature change (e.g. early morning and late afternoon) the thermal difference between the ground and the items are at the maximum thus aiding in detection.

Figure 1 shows a picture of two 500 pound bombs at the test site at Yuma Proving Ground. Figures 2 and 3 show data that was taken by REMIDS of the two 500 pound bombs. These pictures show how man-made materials stand out from the background.

ITRI personnel have had a vital role in all aspects of the operation of the REMIDS system since 1995. They have provided engineering and physics support in repair and upgrade of system components. The airborne system operates in a fairly rugged environment which causes regular system component failure. Some of the parts had to be either replaced or refurbished to make the system as a whole operational. IITRI personnel have played a key role in reconditioning, re-engineering and re-calibration of the many of the sub-systems that make up REMIDS.

IITRI personnel assisted in flight operation through in-flight data collection and ground support. REMIDS is not an automated system and must be tended for data acquisition. One or more operators are needed in the helicopter to run the machine, as well as two or more people on the ground to direct flight operations (unless a "crop-dusting" Global Positioning System has been installed).

IITRI personnel have also provided post-processing support of collected data. The first step in data analysis is reducing the collected data to the data that is only in the area of interest. If a "crop-dusting" GPS system has been used then time stamping is used to determine what is "on-target" and what is not otherwise an operator must view the tapes and mark the start and end markers for each run on the tape. Next is the analysis of this data using "smart" codes to locate the munitions. These are then spot checked by human operators to verify the accuracy of the codes.

This project is waiting for further funding to continue operations and upgrades. There are several proposals pending for FY00 and FY01 for verification of cleanup at Formerly Used Defense FUD sites as well as one for further research and development on the system.

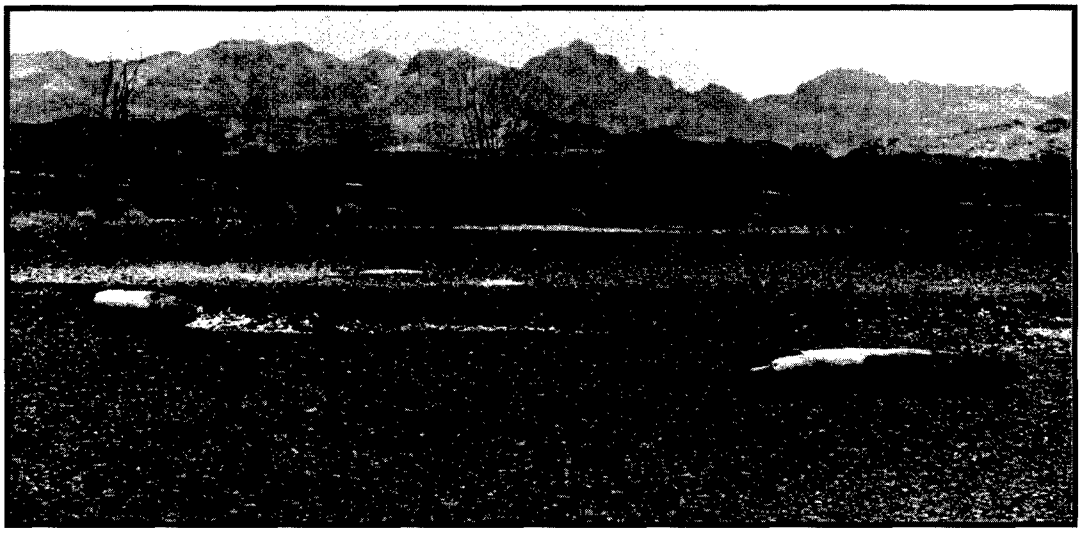
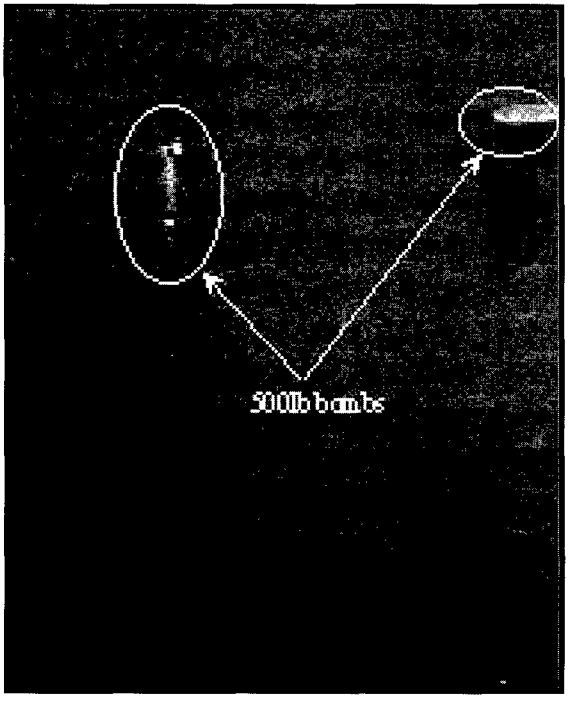


Figure 1. Picture of 500 Pound Bombs

Figure 2. Polarization Image of 500 Pound Bombs Taken with REMIDS System



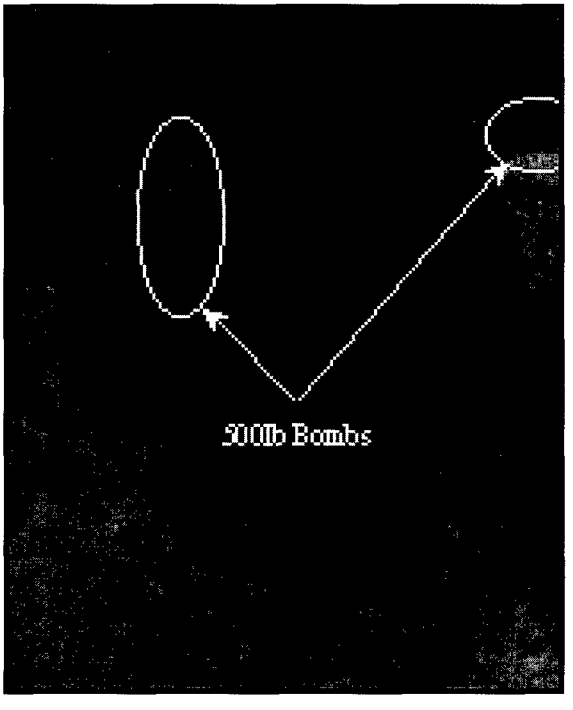


Figure 3. Reflectance Image of 500 Pound Bombs Taken with REMIDS System

Micro Air Vehicles –
Toward a New Dimension in Flight

by James M. McMichael
and
Col. Michael S. Francis, USAF (Ret.)
formerly of DARO

Why Micro Air Vehicles?

Why "micro" Why not something larger? The answer lies in the applications envisioned for MAVs. Studies like the Defense Science Board's 1996 Summer Study on "Tactics and Technologies for 21st Century Warfighting" emphasize keeping personnel out of harms way by providing unprecedented situational awareness right down to the platoon level. In contrast to higher-level reconnaissance assets like satellites and high altitude UAVs, MAVs will be operated by and for the individual soldier in the field as a platoon-level asset, providing local reconnaissance or other sensor information on demand, where and when it is needed. MAVs may also be used for tagging, targeting, and communications, and may eventually find application as weapons, as well.

The reconnaissance application is a primary driver behind the first generation of MAVs. Micro sensors like those mentioned earlier suggest the possibility of reduced latency and greatly enhanced situational awareness for the small unit or individual soldier. This is partly attributed to the direct connectivity envisioned between these systems and the "user" in emerging operational concepts. Direct connectivity means the user has to carry it. So the MAV must trade favorably with other soldier assets - like water and ammunition. The system must also be affordable. It must have a vanishingly small logistics tail, and for many missions it must be intrinsically covert. All this points to a highly compact, small system.

Additionally, the MAV's ability to operate in constrained environments like urban canyons and, eventually, even the interior of buildings, gives these systems a level of uniqueness unmatched by other concepts. MAVs are not replacements for previously manned air vehicle missions; because of their size, they will be capable of completely new missions not possible with any existing systems.

More on Missions

Micro Air Vehicles will be capable of a wide range of useful military missions. The one most often identified by users is the textbook, "over the hill" reconnaissance mission illustrated in Figure 1. The current concept suggests that reconnaissance MAVs need to range out to perhaps 10 km, remain aloft for up to an hour, reach speeds of 10 to 20 m/s (22 to 45 mph), and be capable of real time day/night imagery. In contrast, some surveillance applications may require less range - payload performance. In these instances, the MAV would relocate to a suitable vantage point and serve as a fixed, unattended surface sensor with capabilities ranging from imagery to seismic detection.

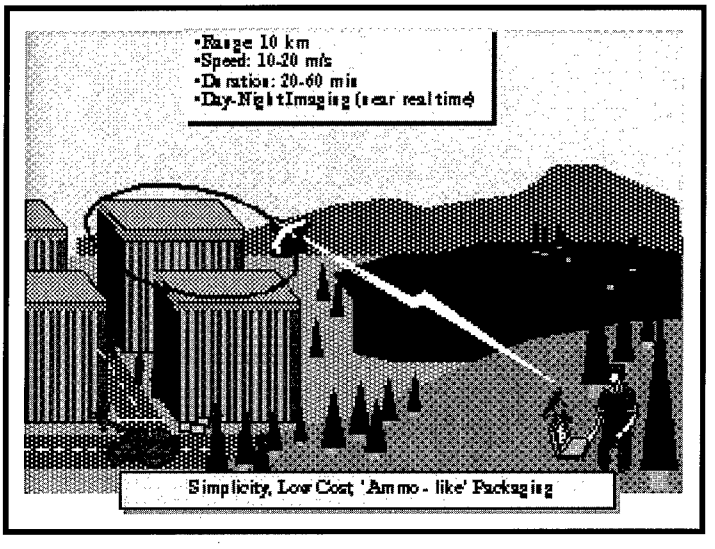


Figure 2. The "Over-The-Hill Reconnaissance" Mission

At the same time, MAVs must be launched and operated relatively simply with an easy-to-operate ground station. Ground stations may employ directional antennas to maintain contact with the MAV at long range.

continues, page 6 ➤

➤ continued from page 5

In urban operations (see Figure 2), MAVs, acting in small, cooperative groups, will enable reconnaissance and surveillance of inner city areas, and may serve as communication relays. They may also enable observations through windows, and sensor placement on vertical and elevated surfaces. Their application to building interiors is the most demanding envisioned. The capability to navigate complex shaped passageways, avoid obstacles and relay information will require yet another level of technology.

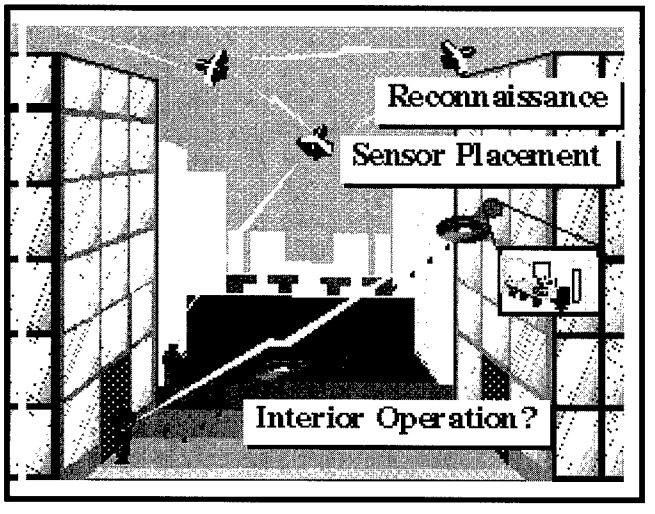


Figure 2. Urban Operations Missions for the MAV

Biochemical sensing, illustrated in Figure 3 is another potential mission for MAVs. With gradient sensors and flight control feedback, MAVs will be able to map the size and shape of hazardous clouds and provide real time tracking of their location.

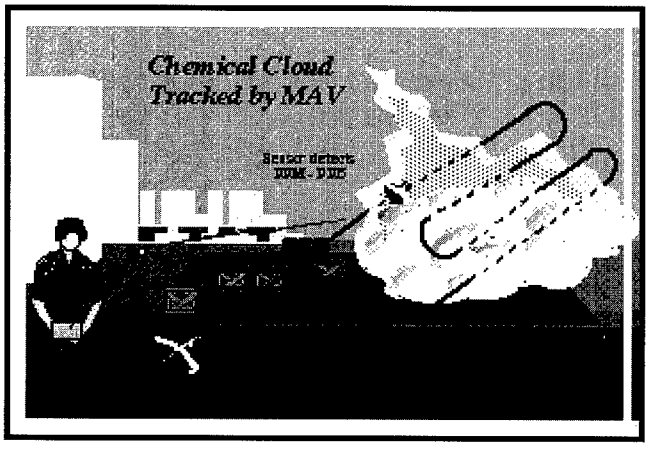


Figure 3. The MAV as a Mobile Immersion Sensor

MAVs may also find application in search and rescue operations. An MAV could be packed into the ejection seat mechanism on fighter aircraft. If the pilot has to "punch out", the MAV is released from the ejection seat and lingers in the air for up to an hour, providing the downed pilot with reconnaissance information, or sending a signal to rescue vehicles.

While the challenge of developing self-propelled MAVs capable of achieving all the requirements alluded to previously is daunting, a more near-term application may be possible using assisted propulsion. Unpropelled MAVs could be launched from overhead flight vehicles or from barrel-launched munitions. Upon release above a target area, MAVs could provide targeting information and battle damage assessment back to the operator.

A large number of potential commercial applications also exist. These include traffic monitoring, border surveillance, fire and rescue operations, forestry, wildlife surveys, power-line inspection and real-estate aerial photography, to name a few.

The Technical Challenge

The development and fielding of militarily useful MAVs will require overcoming a host of significant technology and operational obstacles.

...Putting it Together

The physical integration challenge is believed to be the most difficult problem, the degree of which increases dramatically with decreasing vehicle size or increasing functional complexity. At and below the 15 cm scale size, the concept of "stuffing" an airframe with subsystems - our conventional approach to hardware integration - becomes extremely difficult. An examination of the range of system elements illustrates the problem (Figure 4).

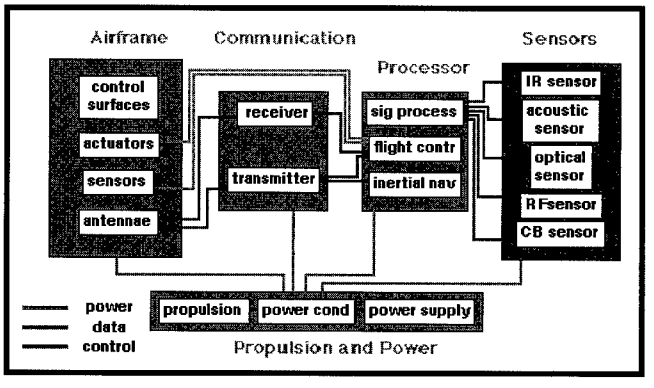


Figure 4. MAV System Integration

continues, page 7 ➤

➤ continued from page 6

Many of the system functions depicted will be provided by microelectronics or MEMS-based components. Even so, separate modules for each function would consume more volume than may be available. From an electronics perspective, the on-board processor and communications electronics form the core of the vehicle. They provide critical links between the sensor systems and the ground station, and they are vital to the flight and propulsion control systems. In the scheme depicted in Figure 4, power generation and propulsion subsystems support critical electronics and flight control functions in addition to flight propulsion power. The multifunctionality required by the MAV weight and power budgets may be achieved only by a highly integrated design, with physical components serving multiple purposes, or accomplishing multiple and often diverse functions. For example, the wings may also serve as antennae or as sensor apertures. The power source may be integrated with the fuselage structure, and so on. The degree of design 'synergy' required has never been achieved in a flight vehicle design.

...Achieving Stable Controlled Flight

Flight control is the single technological area which harbors the largest numbers of unknowns for the MAV designer. Relatively large forces and moments can be produced by the laminar-flow-dominated flight environment, and they are difficult to predict under all but the most benign flight conditions. Unsteady flow effects arising from atmospheric gusting or even vehicle maneuvering are far more pronounced on small scale MAVs where inertia is almost nonexistent, that is, where wing loading is very light. Platform stabilization and guidance will require rapid, highly autonomous control systems.

One common trend in aircraft and in nature is that smaller flyers travel slower and tend to have a higher ratio of wing area to vehicle weight. Given the limited wingspan available, MAVs may have to achieve high relative wing areas by having larger chords, i.e. by using configurations with low aspect ratio (wingspan divided by chord), more like flying wings, or butterflies. So MAVs may have to cope with fully three-dimensional aerodynamics. Here, there are even less low-Reynolds number data available than there are for two-dimensional airfoils. To make matters worse, MAVs will experience highly unsteady flows due to the natural gustiness (turbulence) of the atmosphere. Interestingly, nature's flyers of the same scale use another source of unsteady aerodynamics, flapping wings, to create both lift and propulsive thrust. For some applications, MAVs may ultimately have to do the same.

These low Reynolds number effects will have to be mastered using highly integrated flight control systems, with autonomous stabilization. In confined areas like urban canyons and interior spaces, autonomous collision avoidance systems will also be required.

...Getting From Here to There

Small scale propulsion systems will have to satisfy extraordinary requirements for high energy density and high power density. Acoustically quiet systems will also have to be developed to assure covertness.

To better understand some of the propulsion issues, consider the power equation for a propeller driven aircraft as shown in Figure 5. This relationship provides insight into ways to reduce the power required for propulsion. First, we need good aerodynamics (high lift to drag ratio). But low Reynolds number wings may only have 1/3 to 1/4 the lift to drag ratio of conventional aircraft. Propeller aerodynamics must also be efficient, but propellers below about 3 inches in diameter have poor efficiency, on the order of 50 percent less. So low Reynolds numbers affect propulsion in two ways: Poor lift to drag ratios increase the power required, and propeller efficiencies are low.

The power required can be reduced considerably by having low wing loading, achieved in MAVs by having large wing areas and lightweight vehicles. The Gossamer Albatross had a huge wing area (and low weight) so that it could be powered by a very weak engine (human power). But this was done with huge wing spans. In contrast, the 15 cm limitation means MAVs may have to maximize area by increasing the wing chord, leading to low aspect ratio configurations.

Finally, still in reference to the power equation, there's nothing more effective than low weight to reduce power requirements. Technologies like MEMS, low power electronics, and component multifunctionality will help. High energy density (i.e. light-weight) power sources are essential. Battery-based systems will likely power the first generation MAVs, but more exotic technologies like fuel cells are being developed for follow-on systems.

continues, page 8 ➤

continued from page 7

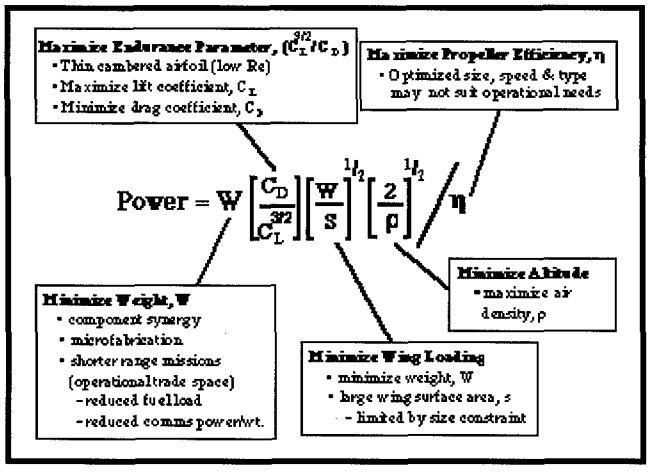


Figure 5. Minimization of MAV Propulsive Power

Approved for Public Release, Distribution Unlimited

If the power and propulsion problems appear daunting, the issue of navigation may be even more so. Large reaches of open air environments may render this problem doable with in-hand technology, but the more demanding environments to which the MAV is uniquely suited are another matter. GPS would be a near-ideal solution, but current systems are much too heavy and too power-intensive for MAV applications. Inertial navigation for MAVs awaits the development of low-drift micro gyros and accelerometers. Constricted corridors of complex geometry, multiple obstacles—and some of them moving must all be reckoned with if the MAV is to become useful to the warfighter. Real time human interaction to provide vehicle stabilization and guidance is being considered for early designs, but performance or other mission constraints may render this solution impractical in some of the more demanding applications. For example, necessary vehicle agility (or gust response) may well surpass a human operator's ability to cope with it, and real-time human controls may not be possible except in the simplest of scenarios. Clearly, significant advances in miniature navigation, guidance and control systems are needed.

Note: Continued in next issue.

Browse the Electronic Library

The DTIC Review brings its readers the full-text of selected technical reports and a bibliography of other references of interest under one cover.
http://www.dtic.mil/dtic/review/
Volume 4, Number 4: "Urban Warfare" Aug 99
Urban Warfare is extraordinary in its demands on ground and air forces. This publication is designed to highlight information and lessons learned that can be applied to conducting military operations in an urban environment.
Available in .pdf at http://www.dtic.mil/dtic/review/vol4-number4.html
Other titles available at this site:
"Bioterrorism: A Grim Reality" Jan 99
"Unmanned Aerial Vehicles" Sep 98

National Defense Industrial Association (NDIA) Conference Proceedings.
The following site provides links to full-text documents of the most recently held conferences sponsored by NDIA: http://www.dtic.mil/stinet/ndia/
Recent additions:
Ninth Annual SO/LIC Symposium Exhibit
Non-Lethal Defense III
Aircraft Survivability: A Vulnerability Perspective
48th Annual Bomb and Warhead Technical Symposium
Armaments for the Army of the Future
Small Arms Systems Section Annual Conference, Exhibition and Firing Demonstration

NEW EMC AWARENESS

A three-day short course
presented by the

WSTIAC

Weapon Systems Technology Information Analysis Center

Course Schedule

23 May – Ft. Monmouth, NJ

25-27 July – Wright-Patterson AFB, OH

12-14 September – San Diego, CA

WHAT IS ELECTROMAGNETIC COMPATIBILITY (EMC)?

EMC DEFINITION:

The ability of electronic equipment to operate in intended operational environments without either:

- causing unacceptable degradation to other equipment in the environment, or
- experiencing unacceptable performance degradation from electromagnetic interference from other environmental equipment.

WHY SHOULD I BE CONCERNED ABOUT EMC?

DoD policy mandates that all new communications-electronics (C-E) systems, as well as modifications to existing C-E systems, will be electromagnetically compatible with their intended operational environments and will comply with established rules and regulations regarding spectrum use. In fact, C-E systems that have radio frequency (RF) emitters cannot be fielded until an approved operational frequency allocation has been obtained from the US Military Communications-Electronics Board (MCEB) and favorable frequency supportability comments have been received from cognizant host nations. As a consequence, it is prudent for material developers and maintainers to consider the attainment of EMC at all stages of the system life cycle.

COURSE OBJECTIVES

Department of Defense (DoD) acquisition regulations mandate that electromagnetic compatibility (EMC) be a critical system characteristic throughout the life cycle of all spectrum-dependent systems/equipment. The objective of the "EMC Awareness" course is to provide the developers, operators, testers, and maintainers of military spectrum-dependent systems and equipment a basic understanding of their responsibilities for participation in the DoD EMC Pro-gram, compliance with military standards, and the provisions of the regulations governing the frequency allocation/assignment and spectrum management processes.

In addition, the course provides brief overviews of the subjects of radio-wave propagation, antennas, communications systems, radar, and electronic systems as they relate to EMC.

WHO SHOULD ATTEND

System planners and managers, engineers, equipment developers/maintainers, testers, operators, and others dealing with spectrum-dependent technologies/systems who need to understand spectrum management rules, regulations, and procedures.

Although some of the material presented is technical, it is presented from a management perspective that can be understood by non-technical attendees.

continues, page 10 ➤

continued from page 9

COURSE OUTLINE

The "EMC Awareness" course consists of six instructional sessions presented over a three-day period. Subject matter addressed includes:

Introduction/Overview
DoD EMC Program
DoD Joint Spectrum Center
EMI/EMC Testing
Spectrum Management
Frequency Allocation
Frequency Assignment Environmental Concerns
EMC Databases
Environmental EMC Analysis
System Performance and Performance Degradation
Cosite Considerations
Communications Systems
Radar
Satellite Systems
Navigation Systems
Electronic Warfare (EW) Considerations
Electronic Warfare Vulnerability Assessment (EWVA)
Radio-Wave Propagation
Radio Noise
Antennas
EMC Analysis Models
EMI Mitigation Techniques

In addition, the attendees will be afforded the opportunity to apply what they have learned from the course by solving sample EMC problems.

Copies of the slides presented during the course, along with supplemental reference materials, will be provided to all attendees. All material presented in the course is UNCLASSIFIED.

COURSE CONTENT

INTRODUCTION/OVERVIEW

The fundamental engineering basis for achieving EMC is introduced and problems associated with conducting EMC analyses are addressed.

DoD EMC PROGRAM

A brief summary of the life-cycle responsibilities for EMC imposed on system developers, users, and maintainers by DoD Directives 5000.1, 3222.3, 4650.1, and 5100.35. Service regulations implementing these directives are discussed, as appropriate.

JOINT SPECTRUM CENTER

A brief overview of the mission, organization, and services provided by the Joint Spectrum Center (JSC).

EMC TESTING

Requirements of system EMI Control Plans. EMC testing provisions imposed by MIL-STD-461 and MIL-STD-464.

SPECTRUM MANAGEMENT

The reason for achieving EMC is to provide a mechanism for effectively managing the use of the electromagnetic spectrum. This module presents an overview of the spectrum management process within the statutory constraints imposed by national and international spectrum regulatory organizations. The concepts of frequency allocation, allotment, and assignment are introduced, along with those of frequency "reuse" distance(s) and frequency assignment guardbands.

FREQUENCY ALLOCATION

An introduction to the national and international frequency allocation tables. Information requirements of the frequency allocation application.

FREQUENCY ASSIGNMENT

Request and approval channels for obtaining operating frequency assignments for C-E systems/equipment.

ENVIRONMENTAL CONCERNS

During its operational life cycle, a military C-E system will be required to operate in a number of electromagnetic environments... e.g., current/ future, peacetime/wartime, domestic/international, test and training/tactical, etc. Each of these environments, all of which must be addressed in establishing the EMC of the system, imposes its own set of constraints on achieving EMC. This module focuses on the information requirements, both defining the constituents of the environment and the technical operating parameters of those constituents, for performing EMC analyses.

EMC DATABASES

The contents of the various JSC EMC-related databases are discussed. The information pro-vided by the Center's Frequency Assignment; Equipment Characteristics; Spectrum Certification; Platform Configuration, TO&E, and Scenario/Deployment; and Geographic/Geophysical data files are addressed.

➤ continued from page 10

ENVIRONMENTAL EMC ANALYSES

In environmental intersystem EMC analyses, most EMI interactions involve relatively small interfering signals. This session introduces the EMC analysis process. Analysis conditions, assumptions, and approximations are discussed.

SYSTEM PERFORMANCE AND PERFORMANCE DEGRADATION

This module focuses on the relationships between system performance and the technical operating parameters of various types of C-E systems and the tradeoffs that generally must be made between mission-related performance and EMC.

COSITE CONSIDERATIONS

In cosite situations, special consideration must be given to the non-linear EMI effects caused by large interfering signals. These considerations include: receiver desensitization and saturation; the generation of transmitter and receiver intermodulation products; harmonic signal generation and spurious responses; and high-power effects such as case penetration, component burnout, and radiation hazards.

COMMUNICATION SYSTEMS

Various military applications of communications systems are introduced. EMC concerns/problems associated with individual applications are discussed. Tradeoffs between desirable system performance characteristics and EMC are examined.

RADAR

A brief summary of radar theory, focusing on the impact of performance criteria on system design is presented. Tradeoffs between desirable system parameters and EMC are examined.

SATELLITE SYSTEMS

Various uses of satellite systems are discussed. Special considerations are introduced.

NAVIGATION SYSTEMS

Certain types of radionavigation systems present unique problems to the EMC analyst.

ELECTRONIC WARFARE CONSIDERATIONS

Electronic countermeasures (ECM) systems are specifically designed to disrupt and/or degrade the performance of radars and communications systems. Accordingly, they pose a serious fratricide effect to one's own equipment. Techniques for addressing EMI caused by ECM systems are discussed.

ELECTRONIC WARFARE VULNERABILITY ASSESSMENT

All spectrum-dependent systems/equipment are susceptible to some degree to degradation/ compromise when targeted by enemy electronic warfare assets. When system/ operational constraints are considered, some of these susceptibilities translate into vulnerabilities that can be exploited in the field to reduce system effective-ness. The Electronic Warfare Vulnerability Assessment (EWVA) process provides a frame-work for orderly consideration, throughout all phases of the system lifecycle, of the effects of enemy actions taken to reduce the effectiveness of US weapons and C-E systems.

RADIOWAVE PROPAGATION

Accurate prediction of propagation path loss assumes the application of a path loss model appropriate to the dominant mode(s) of propagation between the path endpoints. Electro-magnetic wave phenomena associated with radio wave propagation are defined and discussed, along with the various modes of propagation that may occur. Sources of radio noise are also discussed.

RADIO NOISE

Types and sources of radio noise are addressed.

ANTENNAS

A brief introduction to antenna theory is presented. Radiation patterns associated with various types of linear, aperture, and phased-array antennas are discussed.

EMC ANALYSIS MODELS

A brief introduction to the analytic capabilities of the JSC is presented.

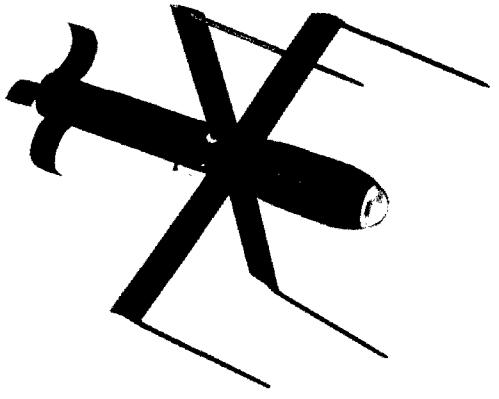
EMI MITIGATION TECHNIQUES

Methods for reducing the impact of EMI are introduced. These include both spectrum-management and system-design-modification fixes.

WSTIAC

Smart Weapons Training

Course Schedule and Locations for FY 2000



For details contact Ms. Jeri McAllister
IIT Research Institute
Phone: 256-382-4700, ext. 4715, FAX: 256-382-4701
Email: jmcallister@iitri.org

15-17 February 2000
Huntsville, AL

14-16 March 2000
Colorado Springs, CO

11-13 April 2000
Las Vegas, NV

16-18 May 2000
Fort Belvoir, VA

13-15 June 2000
Virginia Beach, VA

15-17 August 2000
Huntsville, AL

19-21 September 2000
Omaha, NB

IAC Awareness Conference

The Defense Technical Information Center Information Analysis Center Program Management Office will sponsor an IAC Awareness Conference on May 16, 2000 at the Hope Hotel, Wright Patterson Air Force Base, Dayton, Ohio. The theme of this conference is "Key Challenges" that need to be conquered to enable us to meet Vision 2010. The meeting is open to all Department of Defense (DoD) and associated industry personnel. This meeting will promote IAC Awareness with an emphasis on the needs of the warfighter.

The objective of this conference is to explore the strategic direction and the resulting requirements of information technology and services necessary to support the DoD. To that end, an aggressive agenda with senior-level participants will provide an opportunity to discuss and share valuable insights between Research and Development and the warfighter community.

Those in attendance will include policy makers, DoD program managers, researchers, analysts, information providers, and information users. This conference will address the information needs of the warfighter, along with the current and future information technology initiatives to support those needs in the new millennium. The impact of changes in the policies, procedures, and technologies of information now and in the future and the subsequent impact on DoD will also be addressed.

DoD IACs will have exhibits in the display area highlighting their capabilities, products, and services.

Electronic registration is encouraged via the SURVIAC website at http://iac.dtic.mil/surviac. Additional registration information may be obtained from Ms. Donna Egner, SURVIAC, by telephone: (937) 255-4840, fax: (937) 255-9673, or email: degner@bah.com.

IAC Roundup

by Vakare Valaitis

DTIC is holding two regional conferences this year. The conference covers changes that have taken place at DTIC this past year and what is planned for the future. Enhanced, new and future products and services are described and discussed. Changes to policies and procedures implemented during the past year are highlighted. Internet training is available s well as an update on web-enabled DROLS. This conference provides a forum for users to give DTIC feedback on the issues and problems, which are most significant from their point of view. Open discussion periods ensure that users have adequate opportunity to interact with DTIC, User Council representatives and each other.

The meeting included a presentation on the Information Analysis Center Program emphasizing its alignment with the overall DoD S&T program. Two presentations on Technical Reports included an introduction into the life cycle of DTIC document process from Acquisitions to the final report on STINET or DROLS; as well an overview of changes and additions to the TR database including new collections, on-going projects, as well as the new web-based product for submitting documents to DTIC. The ever-popular presentation on the WWW offered a vast number of tools and sites for successful searching and navigation on the internet. There was a presentation and demonstration of the Air Force Materiel Commands Scientific and Technical Information Transfer System (STINT). This is a web-based interface input vehicle for current research information.

Finally, a session on DTIC's web services detailed the current status, near term plans, and future plans for the including STINET on the Internet, SIPRNET, and the DROLS replacement web service. The agenda and presentations are available at: http://www.dtic.mil/dtic/regconf/westagen1.html

The Western Regional Users Meeting and Training Conference was hosted by the DTIC Western Regional Office in Lawndale, CA and took place 20-21 March 2000.

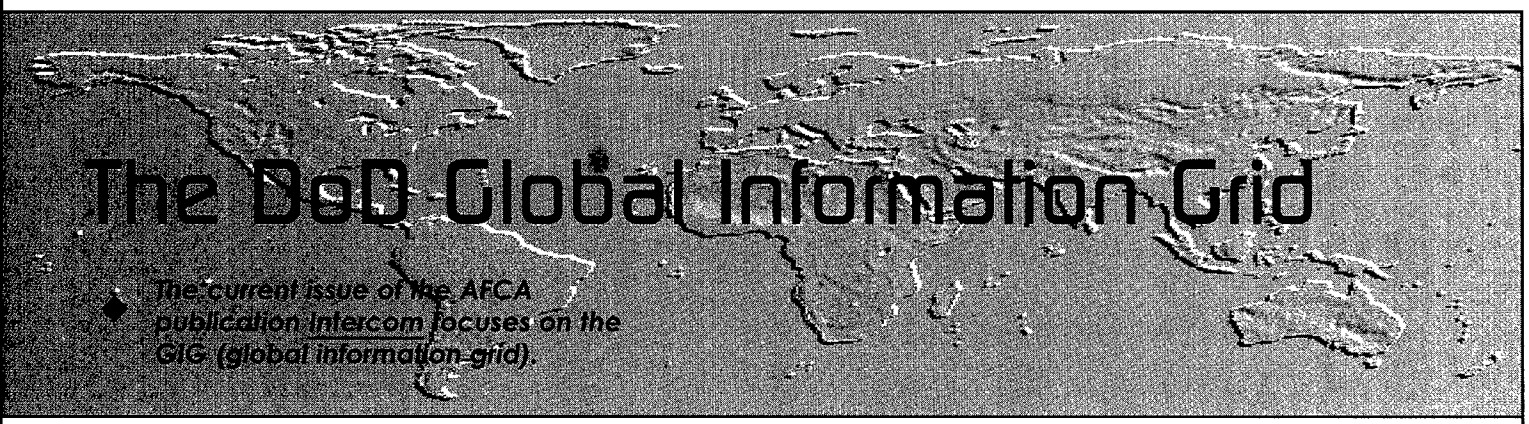
The next meeting will be the Southern Regional Users Meeting and Training Conference on 25-26 April 2000. It will be hosted by the Institute of Surgical Research/Ft. Sam Houston in San Antonio, Texas.

A reminder. The DTIC User Council is an elected group of representative who reflect and articulate the interests of the user community. Its functions are to encourage and facilitate any DTIC operations, plans or cooperative efforts that benefit the membership, expedite the flow of information between the membership and DTIC, make recommendations to DTIC concerning DROLS capabilities, telecommunications, security, hardware, document delivery and other areas of interest. If you have an issue to discuss, are looking for a DTIC POC or another user with concerns similar to your own, contact a member of the council. Contact information is available at: http://www.dtic.mil/dtic/user_council.html.

The WSTIAC Newsletter is the current awareness publication of the Weapon Systems Technology Information Analysis Center (WSTIAC). WSTIAC, a Department of Defense (DoD) Information Analysis Center (IAC), is administratively managed by the Defense Information Systems Agency (DISA), Defense Technical Information Center (DTIC) under the DoD IAC Program. The Contracting Officer's Technical Representative (COTR) for WSTIAC is Mr. H. Jack Taylor, ODUSD (S&T), Defense Pentagon, Washington, D.C. 20301-3080. (703) 588-7405. IIT Research Institute operates WSTIAC, which services Government, Industry, and academia as a Center of Excellence in Weapon Systems Technology.

WSTIAC Director: Richard Hayes
256.382.4700, ext 4746 Email: rhayes@iitri.org
General Information: Carole Simko
312.567.4587 Email: csimko@iitri.org
Database Inquiries: Vakare Valaitis
312.567.4345 Email: vvalaitis@iitri.org
To order WSTIAC products:
Voice: 312.567.4587 Fax: 312.567.4889
Internet: http://wstiac.iitri. org

WSTIAC



The DoD Global Information Grid

The current issue of the AFCA publication Intercom focuses on the GIG (global information grid).

The GIG is the "globally interconnected, end-to-end set of information capabilities, associated processes, and personnel to manage and provide information on demand to warfighters, policy makers and supporting personnel...The GIG supports all Department of Defense, National Security and related Intelligence Community missions and functions (strategic, operational, tactical and business), in war and in peace. The GIG provides capabilities from all operating locations (bases, posts, camps, stations, facilities, mobile platforms, and deployed sites). The GIG provides interfaces to coalition, allied and non-DOD users and systems." (Ref.: ASD (C3I) Memo, 22 Sept.99, Global Information Grid). Anything that sends and/or receives information is a part of the Global Information Grid.

The lead article, written by Lt. Gen. Woodward, Director of the Command, Control, Communications and Computer Systems Directorate, of the Joint Staff, discusses the seven key components of the GIG and demonstrates how it aligns with the information superiority objective in JV2010.

A second article describes the Air Force role in this initiative. The Air Force Global Grid (GG-AF) assures the transport of protected information, linking fixed bases to deployed forces, supports air operations, command control and intelligence and military operations other than war. It is conceived as a four part construct which includes the outside gate, the inside gate, the last 400 feet, and information appliances.

The mission and testing done at the Air Force Network Test Center (Air Force Communications Agency Technology Interoperability Facility) is the topic of another article. The center tests products and systems for "networthiness". That is to say, it certifies the suitability of a system (hardware or software) to operate within a specific environment without degrading it or introducing unacceptable security risks.

Another article defines the architecture that will lay the foundation for the GIG within the Air Force. It cites the mandated requirements for building toward a common operating environment, data elements and communications protocols. The URL for the Air Force Architecture Home-page is http://www.afca.scott.af.mil/architectures/index.htm.) where a wide spectrum of information on frameworks, templates, workshop information, etc is offered.

NETWARS is a modeling tool that helps build, simulate and analyze scenarios for communications within the Global Information Grid. It uses a COTS simulation engine which allows the user to build operational environments. NETWARS was further enhanced by the addition of models specific to military communications equipment. An accompanying toolkit includes a Generic Organization Editor, and Order of Battle Editor and a Force Deployment Editor.

Other articles in the issue include: "Air Force is on target with DOD's Global Information Grid;" "Global Grid: connecting the future;" and ITIAs impart guidance, imply standards, recommend products for implementation." The April issue of Intercom is available full text at http://public.afca.scott.af.mil/public/00apr/current.html.

Calendar of Events

Upcoming Conferences and Courses

1-4 May 2000
35th Annual Gun and Ammunition Symposium
Williamsburg, VA
For additional information call 703.522.1820
Email: mmccrory@ndia.org
http://www.ndia.org/events/brochure/059/059.htm

9-11 May 2000
Perspectives in Emerging IR Countermeasures Technology
MSS Specialty Group on Infrared Countermeasures
Naval Postgraduate School
Monterey, CA
For additional information call IRIA at 734.994.1200 x2881

15-18 May 2000
Systems Thinking and System Dynamics in National Security
National Defense University
Ft. McNair, Washington DC
For additional information call 202.685.2078
Email: saunders@ndu.edu
http://www.ndu.edu/ndu/irmc

20-25 May 2000
3rd Association of Old Crows International Electronic Warfare Conference
Zurich, Switzerland
For additional information call 703.549.1600
Email: cwood@crows.org
http://www.swisscrows.org/conferences/contacts.htm

23-25 May 2000
Infrared Countermeasures
Short Course/Fee: $1295
Georgia Institute Technology
Atlanta, GA
For additional information call 404.385.3501
Email: register@conted.swann.gatech.edu
http://www.conted.gatech.edu/register/

29-31 May 2000
7th St Petersburg International Conference on Integrated Navigation Systems
St Petersburg Russia
For additional information contact:
Dr George Schmidt, Draper Labs
Voice: 617.258.3841 Fax: 617.258.2333
Email: gschmidt@draper.com

12-15 June 2000
2000 Joint Services Small Arms Systems Section Annual Conference
Indianapolis, IN
For additional information call 703.247.2582
Email: mmccrory@ndia.org
http://www.ndia.org/events/brochure/061/061.htm

20-22 June 2000
Threats Countermeasures and Situational Awareness Teaming for Survivability
Electronic Warfare Advanced Technology
Virginia Beach Convention Center
Virginia Beach, VA
For additional information call Norm Papke
812.854.3611
Email: papke_norm@crane.navy.mil

20-22 June 2000
Expanding Our Horizons
68th MORS Symposium
US Air Force Academy
Colorado Springs, CO
For additional information
http://www.mors.org/68morss/front.htm

20-22 June 2000
Coalition Operations in the New Millennium
TechNet International
Washington Convention Center
Washington DC
For additional information http://www.technet2000.org

26-28 June 2000
IAIN/ION 25th Anniversary World Congress
US Institute of Navigation
San Diego CA
For additional information http://www.ion.org

26-29 June 2000
6th Annual Joint Aerospace Weapons System Support, Sensors and Simulation (JAWS3)
San Antonio TX
http://www.ndia.org/events/brochure/092/092.htm

17-20 July 2000
9th Annual AIAA/BMDO Technology Conference
San Diego CA
For additional information call 800.639.2422
http://www.aiaa.org/calendar/bmdo00cfp.html
Email: custserv@aiaa.org